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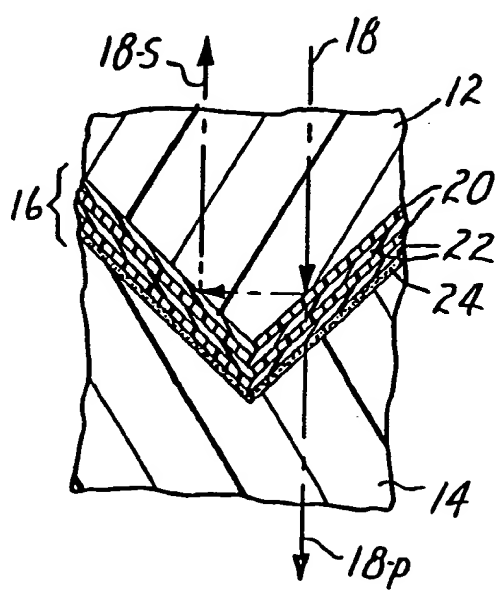

(57) Abstract

A retroreflecting polarizer (10), comprising optical thin films coated on a structured material (12, 14) divides an incident beam of light into polarized components (18-s, 18-p) transmitting one component (18-p) through the polarizer and reflecting the other (18-s) back to the source.

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RETROREFLECTING POLARIZER

Technical Field

This invention relates to polarizing thin film stacks coated onto substrates having structured surfaces.

Background

A MacNeille polarizer comprises alternating repeating layers of a pair of thin film materials deposited on a bulk substrate material. The pair of thin film materials comprises one low refractive index material and one high refractive index material. The indices, called a MacNeille pair, are chosen such that, for a given angle of incidence of a light beam, the reflection coefficient for p-polarized light (r_p) is essentially zero at each thin film interface. The angle at which r_p is zero is called the Brewster angle, and the formula relating the Brewster angle to the numerical values of the indices is called the MacNeille condition. The reflection coefficient for s-polarized light (r_s) is non-zero at each thin film interface. Therefore, as more thin film layers are added, the total reflectivity for s-polarized light increases while the reflectivity for p-polarized light remains essentially zero. Thus, an unpolarized beam of light, incident upon the thin film stack, has some or all of the s-polarized components reflected while essentially all of the p-polarized component is transmitted.

Such a thin film stack is deposited on two general types of substrates, which then classifies the type of polarizer produced as either immersed or non-immersed. For example, if the thin films are deposited on a flat face which forms the hypotenuse side of a right angle

(Porro) prism, and bonded to the similar side of an identical prism, the polarizer is an immersed polarizer. If the thin films are bonded between two planar slabs of transparent media, the polarizer is a non-immersed polarizer. In general, a polarizer is non-immersed if the geometry of the bulk encapsulant does not affect the immersion constant $n_i * \sin(\theta_i)$ of the light beam in a thin film material m_i.

For either immersed or non-immersed polarizers, the p-polarization component of an incident light beam is transmitted, while the s-polarization component is reflected from the thin film stack at an angle equal to the angle of incidence. The total change in direction of the s-polarization component from the incident direction is 90° for cube polarizers and usually about 60° for slab polarizers. Thus, the s-polarization component is typically unavailable for further use, leading to a decrease in overall intensity of light available, unless additional optics are employed to redirect the s-polarization component. For example, U.S. Patent 4,913,529 (Goldenberg et al.) discloses a liquid crystal display (LCD) television projection system using two reflectors, a polarization rotator and a prism to recombine both components.

Such systems are undesirably large for use in many common visual display systems, such as overhead projectors, and especially in portable or laptop computer displays where a thin profile is desired.

Disclosure of Invention

The invention is a retroreflecting polarizer, comprising:

(a) a first material having a structured surface consisting of a linear array of substantially right angled isosceles prisms arranged side by side and

having perpendicular sides which make an angle of approximately 45° with respect to the tangent to a smooth surface opposite the structured surface,

(b) a second material essentially like the first material,

(c) on the structured surface of at least one material, at least one optical stack of alternating layers of high and low refractive index materials of selected optical thicknesses; the first and second materials all optically cemented to form a single unit in which the refractive index of the first and second materials, and the refractive indices and optical thicknesses of the layers of the optical stack, are all chosen to produce selective reflection of polarized light, such that:

(d) within one portion of the optical stack, an incident light beam of mixed polarization is separated into an s-polarized component and a p-polarized component,

(e) the s-polarized component is reflected onto another portion of the optical stack and there reflected parallel to the incident beam but proceeding in an opposite direction, and

(f) the p-polarized component is transmitted parallel to the incident beam.

Brief Description of the Drawing

Figure 1 is a cross sectional view of a portion of one preferred embodiment of the invention.

Figure 2 is an enlarged sectional view of a portion of the embodiment of Figure 1.

Figure 3 is a schematic side view of an optical system employing the invention.

Figure 4 is a graph of the transmissivity and reflectivity of light incident upon one embodiment of the invention.

Detailed Description of the Invention

Figures 1 and 2 show an inventive retroreflecting polarizer 10, comprising two pieces of transparent substrate material 12 and 14, between which is is a composite optical stack 16.

The pieces 12,14 each have structured surfaces (which face each other), and non-structured surfaces. As shown, piece 12 is a top layer and piece 14 is a substrate, but the entire assembly may be inverted with no loss of functionality, essentially interchanging the roles of the two pieces.

In the embodiment shown, the composite optical stack 16 is deposited upon the structured surface of the upper piece 12, and the structured surface of the lower piece 14 is optically cemented (i.e., adhered by a very thin layer of transparent adhesive) to the composite optical stack 16 by an adhesive 24 to form a single unit. However, the composite optical stack could comprise two sub-stacks, one sub-stack deposited on the top layer and the other deposited on the substrate, with adhesive 24 between the two sub-stacks.

The composite optical stack comprises at least one set of pairs of alternating layers of materials having low and high indices of refraction compared to each other. The thicknesses of the layers are chosen such that the quarterwave criterion is met for the wavelength of the incident collimated light beam 18 by each of layers 20 and 22. The shape of the structured surfaces, the optical properties of the substrate material, and the properties of the composite optical stack, all combine to divide the incident light beam into two polarization components. One component, 18-s, is reflected twice in such a manner as to be retroreflected, i.e., directed back toward the source of light beam 18. The other component, 18-p, is transmitted parallel to incident beam 18.

(In Figure 2, the division of incident light 18 into components 18-s and 18-p is shown as occurring at the first interface between the substrate and the composite optical stack, but this is illustrative only. Actually, some division occurs at each interface between thin films, with the net result being as shown.)

In the embodiment shown, the composite optical stack comprises a repeating stack of a pair of materials. One of the materials is a relatively low refractive index (n_L) material 20, and the other is a relatively high index (n_H) material 22. The construction of such a stack 16 is abbreviated $(HL)^2$. In general, more layers are used, such as a $(HL)^5$ stack, and generally the average optical thickness of each material is a quarterwave thick, with reference to a chosen wavelength of interest (typically but not necessarily in the visible spectrum). However, to optimize performance, the individual thicknesses of all thin film layers are varied slightly from the average thickness, in accordance with known principles, using commercially available software to calculate the desired values.

Also, more than two pairs of materials or average thicknesses may be used, such as a $(H_1L_1)^5+(H_2L_2)^5$. This would be done to extend the useful optical bandwidth of the invention or the range of angles over which the invention reflects essentially all s-polarized light.

Each of substrate pieces 12 and 14 comprises a transparent, preferably integral (i.e., a single continuous piece as opposed to an assembly or a laminate) material having a structured surface which consists of a linear array of substantially right angled isosceles prisms arranged side by side. The perpendicular sides of each prism make an angle of approximately 45° with respect to the smooth surface

opposite the structured surface (or, in the most general case of a flexible substrate, with respect to the tangent to the structured surface). Angles other than 45° are useful for other applications, but angles near 45° (e.g., 40° to 50°) are preferred in this invention. This places a constraint on the design of the optical stack: only two of the three indices of refraction (n_L and n_H for the optical stack, n_O for the substrate pieces) can be chosen independently. (An additional implication is that n_L must always be less than n_O if high transmission of p-polarized light is desired at all wavelengths.) These values are determined by the MacNeille condition relating the Brewster angles of each material interface to the numerical values of the indices of the materials forming the interface:

$$\tan(\theta_L) = (n_H/n_L)$$

or,

$$\tan(\theta_H) = (n_L/n_H)$$

along with Snell's law relating θ_O to θ_L and θ_H.

In theory, an infinite set of values of n_H and n_L exist for a given n_O, but in practice, the available choices of materials for the substrate pieces and thin films are limited, and design of the invention reduces to choosing which of the limited set of values of n_H and n_L around that value of n_O will produce the desired results. The greater the difference between n_L and n_H, the wider the optical bandwidth over which the invention will divide incident light into separate polarizations.

A suitable thickness of the substrate is 0.36 millimeters, measured from the smooth surface to the

lowest point of the grooves. Suitable groove heights (measured perpendicularly) are 0.18 mm. For such a film, about 28 peaks per centimeter is preferred, but there is wide latitude in the dimensions.

Preferred substrate materials are flexible, homogeneous, and isotropic. Suitable materials include commercially available acrylics and polycarbonates having nominal indices of refraction of 1.49 and 1.59, respectively. Other possible materials, selected to provide the required functionality, include polypropylenes, polyurethanes, polystyrenes, and polyvinylchlorides. Generally, polycarbonates are preferred for their relatively high indices of refraction, clarity, and physical properties.

Higher index materials include polysulphone (and variations such as polyethersulphone and polyarylsulphone), polyethylene teraphthalate (PET), and polyethylene napthalate (PEN). The sulphones require high processing temperatures, but in turn can withstand higher ambient temperatures in use. PET and PEN may crystallize or exhibit birefringence depending on the process parameters. All these materials have indices in the range of 1.63 to 1.65, and as such, allow the use of the film pair SiO_2/TiO_2 while retaining high transmission of p-polarized light.

A suitable material is taught in U.S. Patent 4,805,984 (Cobb, Jr.), but in this invention the total internal reflection property of that material is not relevant, because the optical properties of the material are significantly changed when it is employed in this invention.

Suitable materials for the thin films 20 and 22 include any materials which are transparent (exhibit low absorption) in the spectrum of interest. For broadband visible light, suitable thin film materials are silicon dioxide (SiO_2) (n=1.45); amorphous

hydrogenated silicon nitride (a-SiN:H) (n=1.68-2.0); titanium dioxide (TiO_2) (n=2.2-2.5); magnesium fluoride (MgF_2) (n=1.38); cryolite (Na_3AlF_6) (n=1.35); zinc sulphide (ZnS) (n=2.1-2.4); zirconium oxide (ZrO_2) (n=2.05); hafnium oxide (n=2.0); and aluminum nitride (n=2.2). Silicon nitride (Si_3N_4) is suitable, but has not been formed successfully on the preferred polycarbonate substrate.

Several thin film deposition techniques can be used to deposit the composite optical stack on the substrate. Thermal and electron beam evaporation, and ion beam sputtering are the methods of choice for precision optical coatings, the latter method producing superior films in terms of adhesion to the substrate, hardness, and environmental stability. Magnetron sputtering is also used extensively for broadband coatings such as anti-reflective coatings on glass, and especially for large area applications such as architectural glass. However, on the whole, thermal and electron beam evaporation should provide good thin film qualities and sufficiently high deposition rates for acceptable manufacturing rates. More importantly, low index films such as magnesium fluoride and cryolite can be deposited by this method. Electron beam deposition is regularly used in the coatings industry for high index materials such as titanium dioxide, zirconium oxide, hafnium oxide, and aluminum nitride.

The process used in the reduction to practice of the invention was plasma assisted chemical vapor deposition (PACVD). Using this PACVD, the following procedures and resultant products are possible.

SiO_2 may be deposited by reacting silane (SiH_4) or almost any organosilane in the PAVCD process with oxygen or nitrous oxide at between 50 and 250 milliTorr, using low power RF plasmas of about 50-100 watt/ft^2 of electrode area. Nitrous oxide is somewhat

preferred because it generally results in less powder formations in the gas phase.

TiO_2 may be formed by reacting titanium tetrachloride ($TiCl_4$) with oxygen and nitrous oxide at the same power levels. By varying both the relative and absolute flow rates of the O2 and N_2O for a given flow of $TiCl_4$ vapor, the index of refraction of the film is easily varied, from 2.0 to 2.4. Residual chlorine in the film can result in poor adhesion to polycarbonate. An oxygen flow of several times in excess of the reactant gas is preferred.

The visibly transparent a-SiN:H material has an index of refraction which varies mainly as a function of deposition temperature, with the higher indices requiring temperatures of 250 Celsius or more. The films may be deposited from mixtures of silane, ammonia, and nitrogen. Films formed at lower temperatures from conditions suitable for high index films (i.e., silane, starved nitrogen, no ammonia) produce undesirably high absorption of blue light. It is possible to form films having indices between 1.68 and 1.8 on polycarbonate below 100 C, with low optical absorption, although the lower index films are somewhat brittle.

The PACVD process was carried out using a deposition system according to the teachings of U.S. Patents 4,841,908 and 4,874,631 (Both Jacobson, et al.). Briefly, this multi-chamber deposition system employs a large volume vacuum chamber within which are plurality of deposition chambers for different composition layers, each chamber having separate seals to minimize back diffusion of any dopant gases from adjacent deposition chambers. A continuous roll of substrate proceeds from a supply roll through each of the deposition chambers and onto a finished take-up roll. The direction of web travel is reversed

repeatedly to produce the multiple layers of repeating refractive index materials.

The index of refraction (n_A) of the adhesive 24 should match that of the upper and lower pieces 12 and 14 as closely as possible. When the index of the adhesive is less than that of the adjoining piece, the non-zero thickness of the adhesive leads to some refraction of light away from the original beam direction. Adhesives of $n_A = 1.56$ are available from the Norlund Company. Suitable adhesives are Norlund numbers 61 and 81 optical cements ($n_A = 1.56$). Another ultraviolet curable resin ($n_A = 1.50$) can be made from Union Carbide number ERL 4221 epoxy resin with 1% (by weight) Minnesota Mining and Manufacturing Company number 41-4201-91185 sulphonium salt initiator. The initiator is dissolved in methelene chloride which must be evaporated off before mixing with the epoxy. Other UV curable mixtures, not as preferred, may be made from urethane acrylate base resins, diacrylate diluents, and suitable photoinitiators. UV curable adhesives may cause slight absorption, mainly in the blue end of the spectrum, in the completed polarizer of about 1-2%. Any thermosetting adhesive or epoxy will work also provided it has low optical absorption and high index.

Example

Alternating thin film layers of matched quarterwave optical thickness were coated on the structured side of a 14 mil thick polycarbonate version of the preferred substrate material described in U.S. Patent 4,805,984 (Cobb, Jr.) In Example 1, coating was done by the plasma assisted chemical vapor deposition (PACVD) process described above, using a 5 inch wide and 8 inch long gas "showerhead" type electrode. To form the retroreflective polarizer, an

uncoated piece of the TIR material was adhered to the optical stack with an optical adhesive.

In Example 1, the polarizer had three optical stacks, each having twelve layers, either silicon dioxide (SiO_2) or titanium dioxide (TiO_2). The unusually high number of layers was required because the PACVD technique as described above did not produce a uniform film thickness near the prism peaks as opposed to the bottoms of the grooves. The first stack had a quarterwave thickness centered at 400 nm, the next centered at 550 nm, the third centered at 700nm. The polarizer performance is shown in Figure 4. Transmissivity of the s-polarization component, T(s), was at or near zero throughout nearly all the visible spectrum, while reflectivity of that component, R(s), approached the 95% level typical of the most efficient common reflectors. Transmissivity of the p-polarization component, T(p), was very acceptable, nearly 80% or more throughout the visible spectrum.

It is useful to provide a few details of the angular dependence of the retroreflecting polarizer. The first feature is the angular dependence of transmission for p-polarized light, through one prism facet. The angle theta is measured in air from the unit vector normal to the outside surface of the retroreflecting polarizer. The assumed film stack is a combination of three stacks designed to cover the visible spectrum at all angles of incidence. The transmission spectrum vs. angle is broader at longer wavelengths (±45° at 650 nm). This stack comprises twenty-eight layers: an eight layer stack centered at 600 nm and 45° (immersed), along with a double stack, of ten layers each, designed for 15°, with center wavelengths of 450 and 600 nm.

The computer calculated angular dependence of transmission, for a wavelength of 450 nm, shows an assymmetry of p-polarized transmission for positive and

negative values of theta. This arises from the inclination of the prism facets at 45° from the substrate surface, whereas the angle theta is measured in air from the normal to the outside surface. Total transmission through the polarizer is the sum of two transmissions, at complimentary angles, through two opposing facets. When both terms are taken into account, the transmission curve is symmetrical. Tertiary and higher order reflections from light transmitted laterally at the second prism can be accounted for as well, but do not have a great impact on the shape of the curve.

Applications

The invention is suitable for applications requiring polarized light that would benefit from increasing the intensity of the polarized light available from an unpolarized source, and especially those requiring polarized light over relatively large areas and/or in relatively compact (especially thin) applications.

For example, the inventive retroreflecting polarizer can be combined in a very simple manner with a quarterwave retardation plate and a reflector to recombine the two components of an incident light beam into a single polarized component of light. Such an arrangement is shown in Figure 3. A combined reflector and source of incident light 118 is illustrated schematically as 130. Incident light 118, having mixed polarization, is not affected by quarterwave retardation plate 120, but is split into components 118-p and 118-s by retroreflecting polarizer 100. Component 118-p is transmitted directly to display device 110. Component 118-s is retroreflected back through a quarterwave retardation plate 120 as shown by 119, and reflected (and displaced transversely upward for clarity as component 121) back through the

quarterwave retardation plate again as shown by 121. The two passes through the quarterwave retardation plate represent a total rotation of 90°, i.e., component 118-s now has the same polarization direction as component 118-p, and is also directed toward display device 110, thus nearly all of the intensity of incident unpolarized light 118 is available in polarized form at display device 110.

The great advantage of the invention in this system is that because all components may be relatively thin and large in area, and lie on essentially the same optic axis, the profile of the system can be greatly reduced. Where reduction in profile is not as much a concern, or where convenient for other reasons, the optic axis can be redirected without loss of generality.

Reflecting source 130 may be the light source of a backlit computer display, or an overhead projector such as models widely available from the Minnesota Mining and Manufacturing Company. Display device 110 may be a group of one or more birefringent LCD panels, employed in monochrome or color applications, such as those disclosed in U.S. Patents 4,917,465 (Conner et al.) and 4,966,441 (Conner).

For this application, assuming a polycarbonate substrate of index $n_0 = 1.586$, the ideal thin film indices are $n_H = 2.0$ and $n_L = 1.35$. With this pair of indices, the theoretical minimum composite optical stack for a photoptic (i.e., covering the entire visible spectrum) retroreflecting polarizer is two sets of eight layers, i.e., $(HL)^4+(H'L')^4$. One set has a bandwidth centered on 425 nm and the other has a bandwidth centered on 650 nm. Although cryolite has the most desired low index ($n_L = 1.35$), it is soft and slightly hygroscopic, so magnesium fluoride ($n_L = 1.38$) is preferred. Zirconium oxide ($n_H = 2.05$) is one

preferred high index material, although several other materials are suitable.

I claim:

1. A retroreflecting polarizer, comprising:

(a) a first material having a structured surface consisting of a linear array of substantially right angled isosceles prisms arranged side by side and having perpendicular sides which make an angle of approximately 45° with respect to the tangent to a smooth surface opposite the structured surface,

(b) a second material essentially like the first material,

(c) on the structured surface of at least one material, at least one optical stack of alternating layers of high and low refractive index materials of selected optical thicknesses;

the first and second materials all optically cemented to form a single unit in which the refractive index of the first and second materials, and the refractive indices and optical thicknesses of the layers of the optical stack, are all chosen to produce selective reflection of polarized light, such that:

(d) within one portion of the optical stack, an incident light beam of mixed polarization is separated into an s-polarized component and a p-polarized component,

(e) the s-polarized component is reflected onto another portion of the optical stack and there reflected parallel to the incident beam but proceeding in an opposite direction, and

(f) the p-polarized component is transmitted parallel to the incident beam.

2. An optical system comprising, along a common optic axis:

(a) a source of incident light of mixed polarization;

(b) a reflector;

(c) a quarterwave retardation plate;

(d) the retroreflecting polarizer of claim 1;

(e) a display device employing polarized light;

in which the p-polarized component is transmitted to the display device, and the s-polarized component passes through the quarterwave retardation plate to the reflector, returning through the quarterwave retardation plate to become a second p-polarized component before proceeding to the display device.

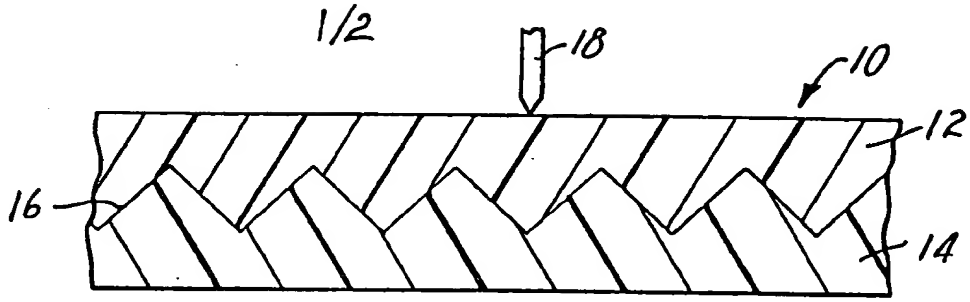

FIG. 1

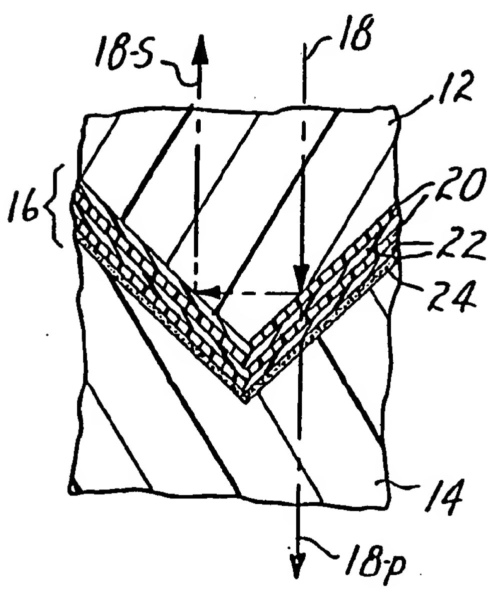

FIG. 2

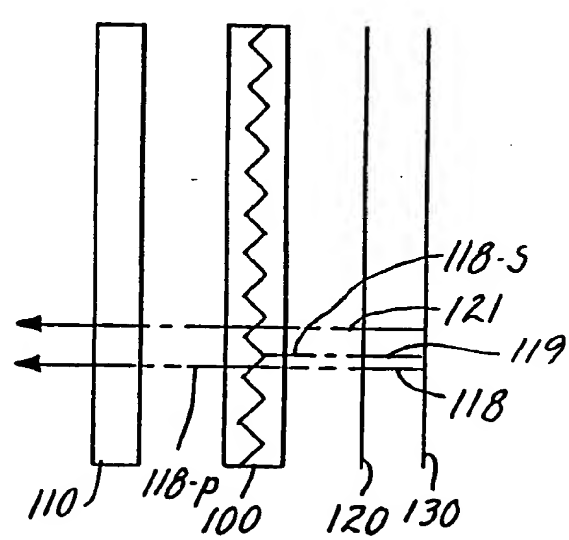

FIG. 3

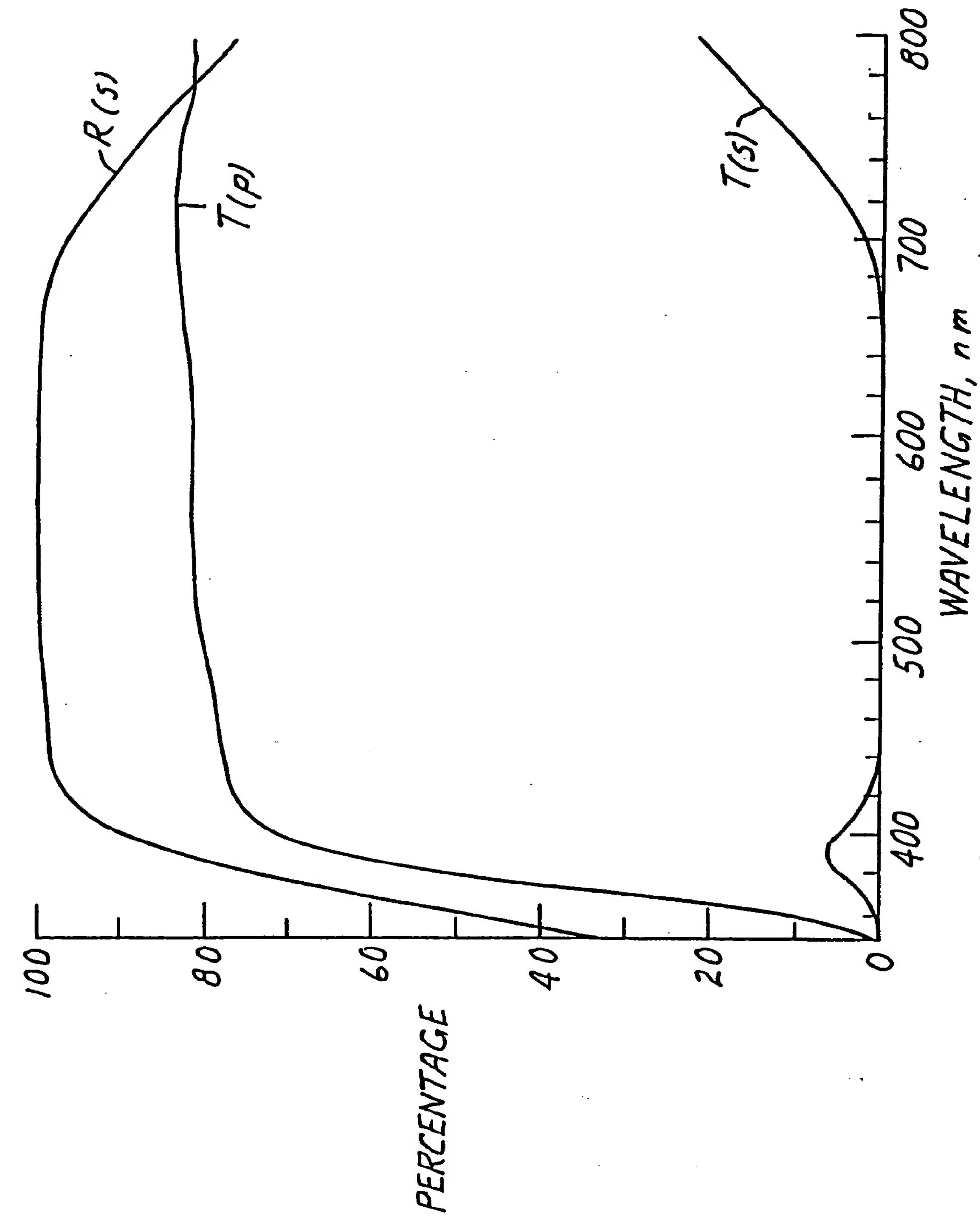
100
80
60
40
20
0
PERCENTAGE
400
500
600
700
800
WAVELENGTH, nm
R(s)
T(p)
T(s)

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/04271

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G02B5/30; G02B5/122

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G02B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	DE,A,2 137 422 (HORST BÄHRING) 8 February 1973 see claims 1,5,6; figures 5,6 see page 6, line 22 - line 34 ---	1
A	EP,A,0 285 397 (SPECTRA-PHYSICS INC.) 5 October 1988 see abstract; claims 1-6; figures 2,3 ---	1
A	EP,A,0 390 344 (MINNESOTA MINING AND MANUFACTURING COMPANY) 3 October 1990 see abstract; claims 1,2 ---	1
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 298 (P-505)9 October 1986 & JP,A,61 114 205 (NIPPON CERAMIC KK) see abstract -----	1

° Special categories of cited documents : [10]

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

1

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16 OCTOBER 1992	30. 10. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VAN DOREMALEN J.C.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9204271 SA 61501

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 16/10/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-2137422	08-02-73	None	
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		US-A- 4751720	14-06-88
		EP-A- 0285398	05-10-88
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		CA-A- 2010201	30-09-90
		JP-A- 2285301	22-11-90

EPO FORM P0479

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

DETAILED DESCRIPTION

[Detailed Description of the Invention]
Source technical field of polarization This invention relates to the light source suitable for generating specific polarization efficiently.
Background technique It is required in application that polarization should function [many] proper. Such one applied example is an optical display like the liquid crystal display (LCD) used widely because of **, such as a dashboard display of a laptop computer, a hand-held calculator, a digital clock, and an automobile. Such other applied things are arrangement of the task lighting for the increase of contrast, and glare (glare) control.
Typically, since polarization is generated, the light source is combined with the polariscope (absorptive) of one or more absorptivity. The dichroic coloring matter which makes polarization of an one direction penetrate from polarization of the rectangular direction is used for these polariscopes. However, since polarization of the rectangular direction is absorbed dramatically, in the point that a practical illuminance is not obtained, a dichroic polariscope has dramatically bad effectiveness. For example, a typical dichroic polariscope lets about 35 - 45% of ******** incident light pass with a standard display back light. Since the light absorbed cannot be used, inefficiency [this] is a serious fault for a dichroic polariscope. For example, in a liquid crystal display, the absorbed light does not contribute to the illuminance of a liquid crystal display, therefore the overall brightness of a liquid crystal display. Although the thin-film-dielectrics polariscope by which vacuum deposition was carried out is not absorptivity like a dichroic polariscope, its responsibility of the direction of an angle is low, and it has other faults that spectral transmittance is not good, to the wavelength besides a design condition. In addition to it, a thin-film-dielectrics polariscope is conventionally covered on a stable substrate like optical glass or the bulk substrate of a polymer. Therefore, to a light weight and application as which a small thing is required, it is past [a bulky] and is heavy.
In the current technique for liquid crystal display lighting, the attempt of polarization control is not made other than the activity of an inefficient dichroic polariscope. In the current technique for task lighting and the glare (glare) control in the display of an automobile, since passing is bulky with the responsibility of inefficiency [of a dichroic polariscope], and the direction of an angle of the thin-film-dielectrics polariscope by which vacuum deposition was carried out, a polariscope is not used at all.
Disclosure of invention The source of polarization of this invention described here has a source of the diffused light (light source of the diffused light, diffuse light source), and the reflective mold polarization element (reflective polarization element) arranged by approaching this source of the diffused light. A reflective mold polarization element reflects desired polarization in through, other polarization is reflected into the source of the diffused light, and it returns. The refused polarization is reflected in the source of the diffused light, and it is returned and randomized. Some of light refused first is changed into desired polarization, and they are sent out through a reflective mold polarization element. This process is continued, the polarization which is not a request is reflected, and the amount of polarization of the request generated by the source of polarization is made to increase by repeating being randomized continuously.

The above-mentioned source of the diffused light consists of a luminescence field and a light reflex, dispersion, and a depolarization field. The light source (solid-state source) of a fluorescent lamp, an incandescent lamp, and a solid-state or the electroluminescent (EL) light source is sufficient as the source of the diffused light.
The leaned dielectric film which was covered on the bulk substrate (bulk substrate) of optical glass or the front face (structured surface) which has the assembled structure is sufficient as a reflective mold polarization element. A multilayer birefringence polymer film is sufficient as a reflective mold polarization element again.
In typical application, the source of polarization is used in order to illuminate an optical display like a liquid crystal display (LCD). For this object, the source of polarization is used combining a means to make polarization reach an optical display. This means can contain free space propagation, a lens system, or the lightguide that maintains polarization.
The source of polarization may be used again in arrangement of various task lighting like fluorescence lighting fitting in the dashboard display or office lighting environment of an automobile. At this time, the source of polarization is placed so that the specific activity location where handicraft or a vision activity is done for glare (glare) control may be provided with an illuminance.
Easy explanation of a drawing The various objects of the source of polarization of this invention, the description, and effectiveness will fully be understood from the following detailed explanation and an attached drawing.
Drawing 1 is the outline block diagram of the source of polarization of this invention. Drawing 2 Cross-section schematic diagram showing actuation of the source of polarization of this invention Drawing 3 A-3C Cross-section schematic diagram of the source of polarization of this invention where the reflective mold polarization element was realized with the bulk optic Drawing 4 A and 4B Drawing showing actuation of the example of drawing 3 A and 3B, respectively Drawing 5 A-5D Cross-section schematic diagram of the source of polarization of this invention where the reflective mold polarization element was realized with the multilayer reflexibility birefringence polarization film Drawing 6 Sectional view where the suitable multilayer reflexibility polarization film was expanded Drawing 7 A-7C Graph which shows the engine performance of a suitable multilayer reflexibility polarization film and a multilayer mirror Drawing 8 A-8D Source of polarization of this invention constituted with the lightguide for drawing polarization Drawing 9 a tolan staple fiber -- REKUTIBU (transflective) -- drawing showing the source of polarization of this invention in the configuration of an optical display Drawing 10 A-10C drawing showing the source of polarization of this invention in various task lighting arrangement -- and -- Drawing 11 A-11B is drawing showing the source of polarization of this invention in fluorescence lighting fitting.
Detailed explanation Drawing 1 shows the outline block diagram of the source 100 of polarization of this invention. The light source 100 contains the reflective mold polarization element 104 arranged by approaching the source 102 of the diffused light, and this source of the diffused light.
Here, "the source of the diffused light" means any light sources which emit the light which has advanced dispersion nature or random nature about polarization and a direction. Suitably, the source 102 of the diffused light consists of a luminescence field and a light reflex, dispersion, and a depolarization field. According to the application for which the source of polarization of this invention is used, the light source (solid-state source) of a fluorescent lamp, an incandescent lamp, and a solid-state or the electroluminescent (EL) light source is sufficient as the source 102 of the diffused light. In a hot cathode lamp which is used in a typical back light mold liquid crystal display, or a fluorescent lamp like a cold cathode lamp, a fluorescent substance offers all the above-mentioned functions. The polarization by which the reflective mold polarization element was refused when the beam of the very often collimated light was required is a luminescence field (for example, a filament or an arc).
It can constitute so that it is alike, and it may return and an image may be made. A luminescence field (for example, a filament or an arc) functions as both the light source and a depolarization field.
A glass substrate, a bulk optic, or the dielectric film covered on the front face which has the assembled structure is sufficient as the reflective mold polarization element 104. Or the reflexibility polarization

film of a multilayer birefringence polymer is sufficient as a reflective mold polarization element.
Drawing 2 is the cross-section schematic diagram showing actuation of the source of polarization of this invention. Since a graphic display is easy, the source 102 of the diffused light and the reflective mold polarization element 104 are arranged and shown in parallel.
However, it will be understood that it is applicable (especially related with the geometric arrangement of drawing 3 A-3C and drawing 5 A-5E) also when the principles of the same optics are other general geometric arrangement again.
The light generated by the source 102 of the diffused light is illustrated by the bundle of rays 120. This light polarizes at random, therefore has a polarization component (a) and (b). Incidence of this light is carried out on the reflective mold polarization element 104. In the 1st polarization (this example polarization component (a)), the reflective mold polarization element 104 is constituted so that through and the polarization (this example (b)) which intersects perpendicularly may be reflected. Therefore, although the light of the polarization component (b) shown by the bundle of rays 122 is reflected, the light of the polarization component (a) described by the bundle of rays 126 passes the reflective mold polarization element 104. The bundle of rays 126 which carries out an outline response is also illustrated in the amount of the light which probably passed if the above-mentioned reflective mold polarization element 104 was exchanged to the dichroic absorptivity polariscope for the comparison.
Suitably, the reflective mold polarization element 104 is efficient to altitude, and there is dramatically little total power dissipation by the absorption in the reflective mold polarization element 104 (it is 1% of order). This lost light is illustrated as a bundle of rays 121. It is reflected, and the refused polarization which is shown by the bundle of rays 122 goes into the source 102 of the diffused light again, and is reflected in the fluorescent substance. For this reason, some of light reflected is randomized and it is effectively changed into a polarization component (a). In this way, the light in which the above was reflected has both polarization components (a) and (b), and appears and comes out of them from the source 102 of the diffused light so that it may be shown by the bundle of rays 124. The source 102 of the diffused light is not a perfect reflector. The optical loss for dispersion and absorption is illustrated by the bundle of rays 123. These loss is also low (it is 20% of order). The light of the polarization component in a bundle of rays 124 (a) passes the reflective mold polarization element 104 so that it may be shown by the bundle of rays 127. It reflects, and the light in the polarization component (b) of a bundle of rays 124 is returned in the source 102 of the diffused light, and is randomized similarly (not shown [this echo]).
As a result, the above-mentioned configuration is a very efficient system, in order to generate desired polarization. A repetition of the echo and randomization which are realized with the combination of the source 102 of the diffused light and the reflective mold polarization element 104 realizes the efficient mechanism for changing light into a condition (a) from a condition (b). In the semantics of instead changing the light which was not able to be conventionally used although absorbed therefore at desired polarization, this system is efficient. In this way, in the source of polarization of this invention, the refused polarization is reflected and it is returned to the light source, and since it is randomized, more light generated from the light source can be used efficiently. Consequently, it is increased by the amount of the whole light generated from that light source in desired polarization. The amount produced as a result of desired polarization is illustrated by bundle of rayses 126 and 127. There may be more it 50 to 60% than the amount of the light (shown by the bundle of rays 126) generated if a dichroic absorptivity polariscope is used instead of the reflective mold polarization element 104.
It depends for the all-out gain of the system on the effectiveness of the reflective mold polarization element 104 and the source 102 of the diffused light. The engine performance of operation has dramatically high reflexibility, and serves as max the source 102 of the diffused light randomized well, and by using the low reflective mold polarization element 104 of absorptivity by low loss.
Drawing 3 A, 3B, and 3C are the cross-section schematic diagrams of the source 100 of polarization of this invention where the reflective mold polarization element was realized using the bulk optic. The source 102 of the diffused light is combined with the reflective mold polarization element containing a polarization beam splitter 112 and the dielectric prism 114 in drawing 3 A. In drawing 3 B, two

polarization beam splitters 112a and 112b form a reflective mold polarization element. In drawing 3 C, the edge 111 which has the notch of lightguide 113 is covered with a dielectric film.
Actuation of the example of drawing 3 A is shown in drawing 4 A. The source 102 of the diffused light generates the light which was shown by the bundle of rays 130 and which has a polarization component (a) and (b). A polarization beam splitter 112 passes the light (bundle of rays 131) of polarization (a), and reflects the light (bundle of rays 132) of polarization (b) in the dielectric prism 114. The dielectric prism 114 reflects the light, it returns to the source 102 of the diffused light, and the returned light is randomized so that polarization (a) and (b) may be included in the source 102 of the diffused light (bundle of rays 133). Here, a polarization beam splitter 112 reflects the light of polarization (b) and (not illustrating) again, although the light (bundle of rays 134) of polarization (a) makes it pass. Therefore, the recirculation of the polarization which is not right will be carried out, and the amount of the light (bundle of rayses 131 and 134) generated as desired polarization will be increased.
Actuation of the example of drawing 3 B is illustrated by drawing 4 B. The source 102 of the diffused light generates the light which was shown by the bundle of rays 135 and which has a polarization component (a) and (b). Polarization beam splitter 112a passes the light (pencil of light rays 136) of polarization (a), and reflects the light (pencil of light rays 137) of polarization (b) in polarization beam splitter 112b. Polarization beam splitter 112b reflects the light, and returns it to the source 102 of the diffused light, and the returned light is randomized so that polarization (a) and (b) may be included in the source 102 of the diffused light (bundle of rays 138). Here, although polarization beam splitter 112a passes the light (bundle of rays 139) of polarization (a), the light of polarization (b) and (not illustrating) is reflected again. Therefore, the recirculation of the polarization which is not right will be carried out, and the amount of the light (bundle of rayses 136 and 139) generated as desired polarization will be increased. Actuation of the example of drawing 3 C is the same as that of drawing 3 B.
As mentioned above, the bulk optical reflective mold polarization element explained with reference to drawing 3 A-3C is efficient in the semantics of not absorbing a serious quantity of light. However, these have other faults. For example, although these are effective on a narrow wavelength band, it is not suitable for application of which a broad spectral response is required. Moreover, a bulk optic has ** and weight increased in the system by which it is used. Therefore, light and small size is not suitable to application in a required place. Moreover, the cost of the system by which a bulk optic is expensive and they are used may be increased substantially.
Drawing 5 A-5D is drawing showing the source 100 of polarization of this invention where the reflective mold polarization element was realized using the multilayer reflexibility polarization film (RPF) 108. In the most general arrangement shown in drawing 5 A, the surroundings of the source 102 of the diffused light are covered so that the multilayer reflexibility polarization film 108 may surround the source 102 of the diffused light thoroughly. In addition to the source 102 of the diffused light, and the multilayer reflexibility polarization film 108, in the example of drawing 5 B-5D, a reflector is included independently. The object of a reflector 109 is turning the light generated from one source 102 side of the diffused light in the direction of an opposite hand. Thereby, many light which polarized is supplied by the predetermined direction. In drawing 5 B, the sense is set to surround one source 100 side of polarization to the reflector 100 (suitably specular reflector). In drawing 5 C, a reflector 109 is located between the source 102 of the diffused light, and the multilayer reflexibility polarization film 108. In this arrangement, a reflector 109 may consider as the shape of a film, or may be attached in the multilayer reflexibility polarization film 108. In drawing 5 D, the one side of the source 102 of the diffused light is selectively surrounded by the reflector 109, and the another side side of the source 102 of the diffused light shows the configuration selectively surrounded with the multilayer reflexibility polarization film 108.
The suitable reflective mold polarization element 108 is a multilayer reflexibility birefringence polarization film (RPF) as shown in the United States patent application 08th transferred to the same grantor as this application in the example of drawing 5 A-5D / No. 402,041 (March 10, 1995 application, "OPTICAL FILM"). In a typical fluorescent lamp, by using a reflexibility polarization film, predetermined polarization increases by 1.5 to 1.6 times when using the light source having no

reflexibility polarization film and same, and if it compares with the case where the same light source is used with a dichroic absorptivity polariscope, it will increase still more greatly. It excels rather than there is dramatically less absorption than the case of a dichroic polariscope and the engine performance about an include angle and wavelength is also obtained using the bulk optic by which vacuum deposition was carried out.

Since in addition to it light is polarized in the light source by combining a reflexibility polarization film with the source of the diffused light as drawing 5 A-5D is shown, the demand to the quality of the front face of a reflexibility polarization film is eased. In this way, since the demand to the quality of the front face of a reflexibility polarization film was eased, even if it uses fewer reflexibility polarization films under the eased manufacture conditions, the amount of the polarization generated increases.

The suitable reflector 109 is the multilayer birefringence mirror of the mold described by the above-mentioned United States patent application 08th / No. 402,041.

Drawing 6 is the general drawing showing the outline of one example of the segment of the multilayer stack 200. A suitable reflexibility polarization film and a multilayer mirror may be made from this multilayer stack 200. In this drawing, X and Y which are referred to in description of the reflexibility polarization film 108 by the above-mentioned United States patent application, and the system of coordinates 146 which define a Z direction are included.

drawing 6 -- setting -- being shown -- having -- a multilayer -- a stack -- 200 -- two -- a ** -- differing -- an ingredient -- "-- (-- A --) -- " -- and -- "-- (-- B --) -- " -- from -- becoming -- alternation -- a layer (ABABA ...) -- from -- constituting -- having -- **** . Each class in the multilayer stack 200 has the refractive index of x and y which were shown as nx, ny, and nz, and z each direction. Optical behavior of a multilayer stack is explained briefly [here], although described by the detail by the above-mentioned United States patent application 08th / No. 402,041.

The relation between the refractive index in each other relation between the refractive indexes in each class of a film and each class of a film and the refractive index of other layers in a film stack determines optical behavior of a multilayer stack. The polariscope of a reflective mold may be made by extending such a multilayer stack 200 to single shaft orientation, as shown in drawing 6 . In drawing 6 , the refractive index of at least one ingredient in a stack is influenced by enlargement. The enlargement of single shaft orientations produces the refractive-index difference between the layers which adjoin in the direction of enlargement. Although the stack obtained as a result passes the light which has the plane of polarization in the direction of non-enlargement, the light which has the plane of polarization in the direction of enlargement is reflected.

A multilayer mirror may be made by extending the multilayer stack 200 as shown in drawing 6 to 2 shaft orientations. A refractive-index difference arises in both extended directions by the 2 shaft-orientations enlargement of a multilayer stack. In this way, the reflection factor of light becomes high by both plane of polarization.

Drawing 7 A-7C shows the penetrable ability of one example of a reflexibility polarization film. These two films are described more by the detail in the above-mentioned United States patent application 08th / No. 402,041.

The reflexibility polarization film of drawing 7 A is the multilayer stack of polyethylenenaphthalate (PEN) and a copolymer (coPEN). A copolymer consists of 2 [70 mol %], 6-naphthalene JIKABOKISHI rate methyl ester, % of 15-mol dimethyl isophthalate, % of a 15-mol dimethyl TAFUTA rate, and ethylene glycol (the United States patent application 08th / example 10 reference of No. 402,041). The transparency at the time of the vertical incidence of light in case Curve a has plane of polarization in the direction of non-enlargement is shown, the transparency at the time of 60-degree incidence of light in case Curve b has plane of polarization in the direction of non-enlargement is shown, and Curve c shows the transparency at the time of the vertical incidence of the light which polarized in the direction of enlargement.

The reflexibility polarization film of drawing 7 B is the multilayer stack of Above PEN and SHINCHI nerd tick (synchotactic) polystyrene (sPS) (the United States patent application 08th / example 11 reference of No. 402,041). The transparency at the time of the vertical incidence of light in case Curve a

has plane of polarization in the direction of non-enlargement is shown, the transparency at the time of 60-degree incidence of light in case Curve b has plane of polarization in the direction of non-enlargement is shown, and Curve c shows the transparency at the time of the vertical incidence of the light which polarized in the direction of enlargement.

The direction of incident light is changed and most quantity of light is emitted in the direction from which it separated from the shaft from the source of the diffused light by the randomization which takes place in the source of the diffused light. Therefore, the path length in the reflective mold polarization element of such a light is longer than the path length of a vertically near light. In order to optimize optical behavior of a system, it must be cautious of this effectiveness. In order to fit the beam of light of the direction from which the suitable multilayer reflexibility polarization film 108 separated from the shaft unlike the dichroic polariscope or the reflective mold polariscope by the bulk optic explained here to shorter wavelength, an echo of the broadband to the direction of the twist long wave length for whom it asks at the time of vertical incidence is enabled.

Therefore, the example of the source of polarization of this invention which is using the suitable reflexibility polarization film has some advantages. The process of the echo attained with the source of the diffused light and the reflexibility polarization film and randomization realizes the very efficient source of polarization. The reflection factor of the broadband attained with the reflexibility polarization film means that it is efficient in a broad spectral range. In addition to it, the reflection factor of the polarization by which the direction from which it separated from the shaft with the reflexibility polarization film was refused becomes high. These descriptions make useful combination of a reflexibility polarization film / source of the diffused light in the broader range of an include angle in the broader range of the spectrum of light as compared with the example which has taken in the bulk optic. Furthermore, a reflexibility polarization film is lightweight, and thin, and flexible. This is suitable for the application whose weight the volume is small and needs the light thing. A reflexibility polarization film suits on a lamp front face well again, and may be built into lamp manufacture.

a suitable mirror is manufactured like a reflexibility polarization film, if it removes that a film is alike in the two directions and is extended. Drawing 7 C shows the spectrum of a multilayer mirror made as follows.

PEN :P. MMA Mirror The film (coextruded film) containing 601 layers by which simultaneous extrusion was carried out was manufactured on the sequential flat film shaping system through the simultaneous extrusion (coextrusion) process. (Consisting of a dichlorobenzene a 60-% of the weight phenol / 40% of the weight) The polyethylenenaphthalate (PEN) which has the intrinsic viscosity of 0.57 dl/g was extruded by extruder A by 114pound/o'clock in rate. Among these, the epidermis layer (skin layer) which explains the remainder below to a feed block in 64pound/o'clock was supplied. PMMA (ICI U.S. CP-82) was extruded by extruder B at the rate of 61pound, and was altogether supplied to the feed block. PEN suited on the epidermis layer of a feed block. in order to generate 151 layers using a feed block as described by U.S. Pat. No. 3,801,429 after simultaneous extrusion of the two symmetrical epidermis layers of a feed block is carried out using the extruder C which measures and supplies [inside] PEN same type by about 30pound/o'clock in rate as having been supplied by Extruder A, feed block sequence was used. This knockout product passed two multiplication machines (multiplier) which produce the knockout product of about 601 layers. U.S. Pat. No. 3,565,985 has described the same simultaneous extrusion multiplication machine. This knockout product passed another equipment which carried out simultaneous extrusion of the epidermis layer 50pound/o'clock in total rate [PEN] from Extruder A. A web (web) is turned in the die-length direction by the web temperature of about 280 degrees F, and the draw ratio 3 [about]. After that, 310 degrees F preheated this film for about 38 seconds, and it was drawn out by the draw ratio longitudinal direction at about 11%/second of rates about 4.5. And the heat setting (heat-set) of this film was carried out at 440 degrees F, without loosening. The thickness of the finished film was about 3 mils (mil).

As shown in the curve a of drawing 7 C, the band at the time of vertical incidence has the disappearance in an average band exceeding 99% (average in-band extinction), and is about 350 nm. The incident angle which makes 50 degrees since vertical showed disappearance with the same light of both s-

polarized light (curve b) and p-polarized light (curve C), and the band was shifted to shorter wavelength as expected. **** of the band of s-polarized light is not shifted to a blue side like p-polarized light for the larger band expected to s-polarized light.
Drawing 8 A shows the lightguide 160 for supplying the polarization generated from the source 100 of polarization and the source 100 of polarization of this invention to the accompanying optical display. Suitably, in order to make polarization control into max in lightguide, the source of polarization polarizes light in YZ (159a) or XZ (159b) flat surface. For the object of this invention, lightguide 100 has suitably the capacity to maintain the polarization condition of the light generated by the source 100 of polarization. The lightguide which fulfills this condition is suitable for the object of this invention.
Drawing 8 B-8D shows the source 100 of polarization of this invention with three examples 161, 166, and 170 of lightguide. As explained above, the lightguide used with the source 100 of polarization of this invention maintains suitably the polarization condition of the light generated by the source 100 of polarization. Each of the example of the lightguide shown in drawing 8 B-8E fulfills the description of this polarization maintenance. It will be understood that it is not what means the lightguide shown in drawing 8 B-8E being shown only for the object of a graphic display, and restricting the lightguide suitable for being used with the source of polarization of this invention. On the contrary, any lightguides with which are satisfied of the demand of polarization maintenance can be considered as instead of [the] as mentioned above also to any of the lightguide shown in drawing 8 B-8E, without deviating from the pneuma and the range to mean of this invention.
Although lightguide 8B-8D is typically manufactured from an acrylic, it may be manufactured from any optical ingredients. Lightguide can be filled with a transparent liquid or the dielectric material of gel in order to remove certainly the birefringence induced by stress.
The lightguide which minced the facet (a facet or ****) shown in drawing 8 B, and the stair-like wedge lightguide mold lightguide shown in drawing 8 C draw light similarly. A beam of light is reflected by total internal reflection along with the guide. The beam of light continues an echo until it reaches a facet (it is (like the facet 163 in drawing 8 B, or the facet 165 in drawing 8 C)). This facet reflects light and emits it through the interface which lightguide counters. Each of such lightguides lets the interface of the opposite hand of a facet pass, and they is designed without the back reflector (specular or diffuse back reflector) of a mirror plane or a diffusion mold so that much of the light may be emitted. By adding a back reflector, the amount of the light drawn through the front end interface of lightguide increases.
The lightguide which had the facet of drawing 8 B minced is designed by fixed thickness so that light can be uniformly taken out covering the whole die length of the guide. The include angle of a facet is shown as 162. It is assumed that the light which hits each facet is substantially the same in angular distribution, and differs only in reinforcement. In drawing 8 B, spacing of a facet is changed along with the die length of a guide, in order to offer this uniformity. A facet approaches more mutually at the end of a guide. The depth of a facet may also be changed along with the die length of a guide, in order to offer this uniformity. The predetermined quantity of light is drawn from a guide at a predetermined rate (rate), and spacing of a facet, the depth of a facet, and the include angle of a facet are chosen so that it may be turned to a predetermined angular domain to the guide of predetermined size.
The stair-like lightguide of drawing 8 C is arranged among them with the 45 (it is (like facet 165)) degree facet arranged at a series of uniform intervals, and has a series of flat surfaces parallel to the topmost part interface of a guide. The rate of guidance **** is rather controlled by reducing guide thickness rather than it is because it approaches more and two or more facets are generally prepared.
The wedge lightguide shown in drawing 8 D draws light by exerting coercion so that the beam-of-light include angle which carries out incidence may turn into an include angle which exceeds the critical angle of total internal reflection exactly. And within the limits of a narrow cone, this light is emitted from a guide and produces higher brightness as compared with the time of the power of the same quantity of light being distributed over a larger angle.
The abbreviation one half of the emitted light is directly emitted from the topmost part interface of a guide. The remaining light is emitted from the bottom interface of this guide. In order to change the direction of the light lost separately and to return through the topmost part interface of a guide, the

specular reflection mirror (not shown) of a high reflection factor may be used.
The thickness of wedge lightguide decreases as are shown in drawing 8 D and light spreads from the lamp to an end. **** is shown by the include angle 172. The rate of optical guidance **** is controlled by **** 172 and thickness of the guide which is changing. By enlarging **** more, the rate from which light is drawn from a guide increases.
Some factors must be taken into consideration in order to decide, which guide fits the best specific application and. These factors contain a viewing angle, brightness, effectiveness, the ease of manufacture, the flexibility of an optical design, the usefulness over other geometric arrangement, and simplicity.
Since the lightguide which maintains the source of polarization of this invention and polarization increases the amount of desired polarization, the need for the dichroic absorptivity polariscope attached in the accompanying optical display decreases.
drawing 9 -- a tolan staple fiber -- REKUTIBU (transflective) -- the source 100 of polarization of this invention in useful arrangement is shown in an optical display. the transparent mode (back light mode) with which, as for such a display, the display is compared by the source 100 of polarization -- or -- or the display may be seen in the reflective mode compared with the bottom of surrounding lighting conditions from before.
In the transparent mode, the source 100 of polarization carries out incidence of the light to the lightguide 180 which maintains polarization so that it may be shown by the beam of light 186. The lightguide 180 which maintains polarization maintains the polarization of light by which incidence was carried out, and also any one of the lightguides described with reference to drawing 8 A-8D so far is sufficient as it, or lightguide like a throat is sufficient as it. Suitably, in order to increase dispersion of light, and the amount of randomization, the diffuse reflection object (diffuse reflector) 109 is established behind the source 100 of polarization. It is reflected with lightguide 180 and the light by which incidence was carried out illuminates the optical display which is taken out out of lightguide 180 and accompanies.
For an activity with reflective mode, the metal or other diffuse reflectors 182 by which brushing was carried out are prepared after lightguide 180. The light of the perimeter shown with a beam of light 184 passes through the accompanying optical display, and passes along lightguide 180, and is reflected on a front face 182. The scattered light offers the contrast for seeing the accompanying optical display.
Therefore, the source of polarization of this invention has many the descriptions and advantages. Display brightness is controlled by adjusting a viewing angle, display area, its absorption loss, and its polarization. According to the source of polarization of this invention, by polarizing light promptly in the light source, the remaining variables can be independently optimized so that brightness, a desired viewing angle, and desired display area may be offered.
The problem of the glare (glare) accompanying drawing 10 A using the typical light source 190 not polarizing in the situation of task lighting is shown. The light of the polarization (a) shown with the beam of light 193 passes a task lighting (it is (like computer screen)) interface, it is reflected and the light of the polarization (b) shown with another side and a beam of light 199 produces a glare. However, in drawing 10 B, the source 100 of polarization of this invention is used. In this arrangement, since it is the polarization (a) the very high rate was indicated to be with the beam of light 195 among the light generated from the source of polarization and passes, a glare is reduced.
Drawing 10 C shows the situation of task lighting like an automobile dashboard display. The reflective mold polarization element 104 is placed on the electroluminescent (EL) panel of a typical automobile dashboard display. In a windshield (windshield) 196, a glare happens without the reflective mold polarization element 104. However, a windshield 196 is passed instead of carrying out the polarization with all the same light shown with the beam of light 197, therefore reflecting, and producing a glare by the reflective mold polarization element 104.
Drawing 11 A shows the example of the source of polarization in fluorescence lighting fitting which is used in an office lighting environment. In this example, fluorescence lighting fitting contains the fluorescent lamp lamp 102 and a reflector 109. RFP108 is placed on the dispersion grid (diffusing grid) 111 by the output side of fluorescence lighting fitting. Suitably, a reflector 109 is the multilayer mirror

which was explained with reference to drawing 7 C.
Or a glare cutback is not required, the example of drawing 11 B may be used in the application which is not required. In this example, the light source 102 of a fluorescent lamp is reflected by the multilayer mirror 100 by the backside within fluorescence lighting fitting covered with the diffusion grid (diffusing grid) 111. In the example of drawing 11 A and 11B, there are some advantages in a multilayer mirror as compared with the vacuum evaporationo (vapor coated) metal mirror traditionally used within lighting fitting. There is less diffuse reflection (less than 2%) of the suitable multilayer mirror for the 1st than the mirror made by vapor-depositing a metal like silver to up to a substrate (5 - 6% of diffuse reflection). Moreover, a suitable multilayer mirror has a very flat spectral response over a visible spectrum. By contrast, from blue, a silver vacuum evaporationo mirror is red and are reflected. [many] Therefore, the color of fluorescence lighting fitting changes seemingly. Since a multilayer mirror does not contain a metal, the problem of pitting experienced by the silver vacuum evaporationo mirror is lost. Next, as compared with the silver vacuum evaporationo mirror which has 92 - 93% of reflection factor, a suitable multilayer mirror has a high reflection factor exceeding 99%. In addition to it, a multilayer mirror may be manufactured at cost lower than a silver vacuum evaporationo mirror.

[Translation done.]

CLAIMS

[Claim(s)]
1. Light Source Optical Randomization Element In Source of Polarization Which Has Multilayer Reflexibility Polarization Film Which is Made to Penetrate 1st Polarization and Reflects 2nd Polarization the amount of the light emitted from said source of polarization said optical randomization element The source of polarization characterized by suiting in order to randomize said reflected polarization of light so that it may increase more than the amount of the light first emitted from said source of polarization, and said a part of reflected light may be changed into said 1st polarization.
2. Said light source is a source of polarization including the source of the diffused light according to claim 1.
3. Source of polarization according to claim 2 where said multilayer reflexibility polarization film is wound around the surroundings of said source of the diffused light.
4. Source of polarization containing stack of two or more layers which said multilayer reflexibility polarization film becomes from PEN and coPEN according to claim 3.
5. Source of polarization according to claim 1 which furthermore contains reflector.
6. Source of polarization according to claim 5 where said reflector contains multilayer mirror.
7. Said multilayer mirror is a source of polarization according to claim 6 constituted by the stack of two or more layers which consists of two or more pairs of polymer ingredients.
8. Source of Diffused Light Which Generates Random Polarization and Light of Direction In Source of Polarization Which Has Multilayer Reflexibility Polarization Film Surrounding Said a Part of Source [at Least] of Diffused Light Said Film The stack of two or more layers which consists of two or more pairs of ingredient layers is provided. So that the 1st polarization penetrates said film, and the 2nd polarization may be reflected with said film and it may be returned into said source of the diffused light To said 1st polarization, a difference does not have between layers each of said layer which are pairs in a refractive index, and it has a difference in a refractive index between layers to said 2nd polarization. Said source of the diffused light randomizes said reflected polarization further. The source of polarization characterized by suiting so that the sense of the randomized this light may be turned in the direction of said film.
9. Source of polarization according to claim 8 which emits said 1st polarization arranged so that glare might be made into min in application to task lighting.
10. Said multilayer reflexibility polarization film is a source of polarization according to claim 1 which has the two or more layers layer which consists of a mutual pair of PEN and sPS.
11. The source of polarization according to claim 10 which has a means for sending the polarization emitted from said source of polarization to an optical display.
12. The means for [said] sending is a source of polarization according to claim 10 which has the lightguide which was combined so that said 1st polarization which penetrated said film might be received, and which maintains polarization.
13. Source of Diffused Light Which Generates Random Polarization and Light of Direction It is Multilayer Reflexibility Polarization Film Surrounding Said a Part of Source [at Least] of Diffused

Light. This Film So that the 1st polarization penetrates said film, and the 2nd polarization may be reflected with said film and it may be returned into said source of the diffused light It is the source for an optical display of polarization which has a multilayer reflexibility polarization film possessing the stack of two or more layers which consists of two or more pairs of polymer ingredient layers. Said source of the diffused light randomizes said reflected polarization further. It suits so that the sense of the randomized this light may be turned in the direction of said film, Said source of polarization Furthermore, the source for an optical display of polarization characterized by having the lightguide which was combined so that said 1st polarization which penetrated said film might be received, and suited so that this polarization might be sent to an optical display, and which maintains polarization.
14. It is fluorescence lighting fitting which has a fluorescent lamp lamp. Fluorescence lighting fitting characterized by having the multilayer mirror installed so that the light emitted with said fluorescent lamp lamp might be turned to the output side of said fluorescence lighting fitting and it might reflect.
15. The source of polarization containing the multilayer reflexibility polarization film installed in the output side of said fluorescence lighting fitting according to claim 14.
16. Said multilayer mirror is a source of polarization according to claim 14 which has a reflection factor exceeding 99%.
17. Said multilayer mirror is a source of polarization according to claim 14 which consists of stacks which have the two or more layers layer which consists of a mutual pair of a polymer ingredient.
18. Said multilayer mirror is a source of polarization according to claim 17 which consists of mutual layers of PEN and coPEN.

[Translation done.]

DRAWINGS

[Drawing 1]

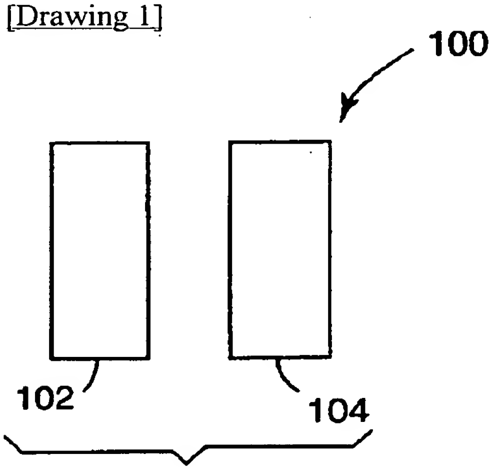


FIG.1

[Drawing 2]

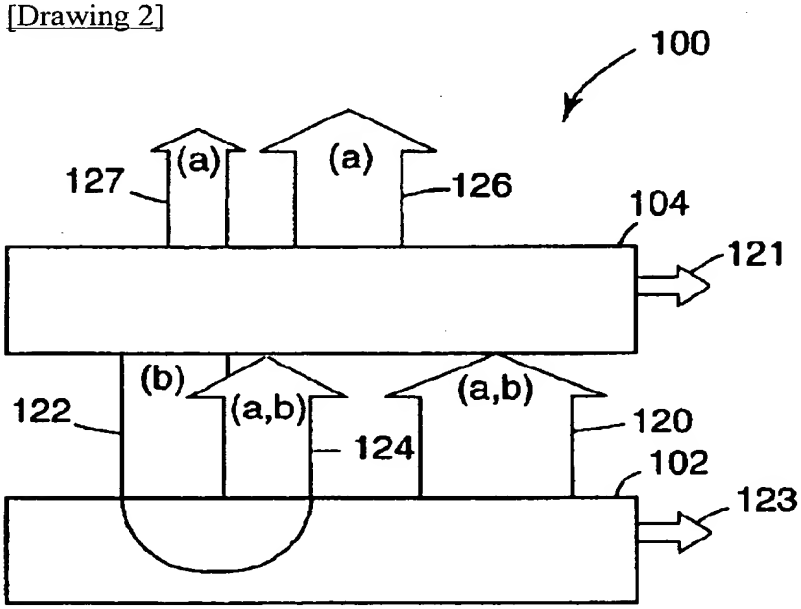


FIG.2

[Drawing 11]

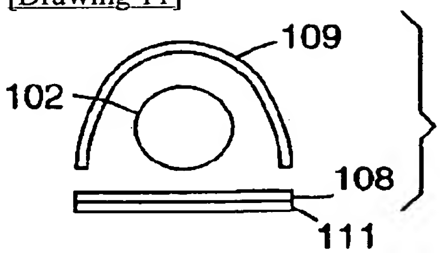


FIG.11A

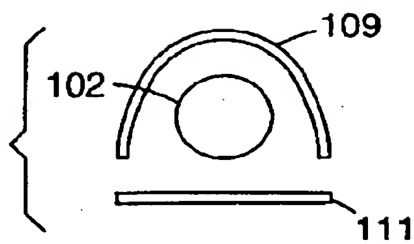


FIG.11B

[Drawing 3]

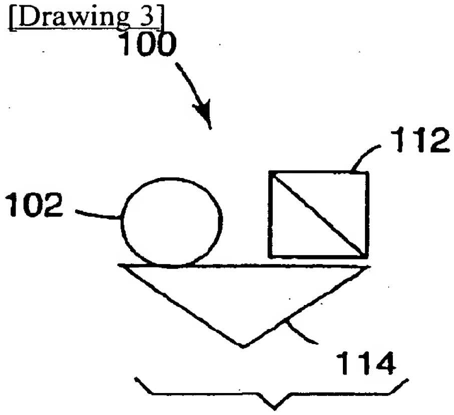


FIG.3A

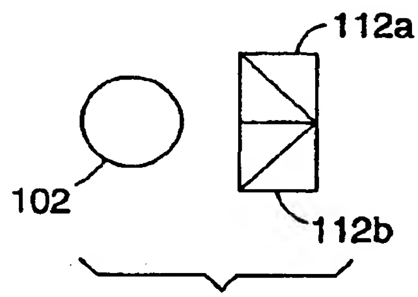


FIG.3B

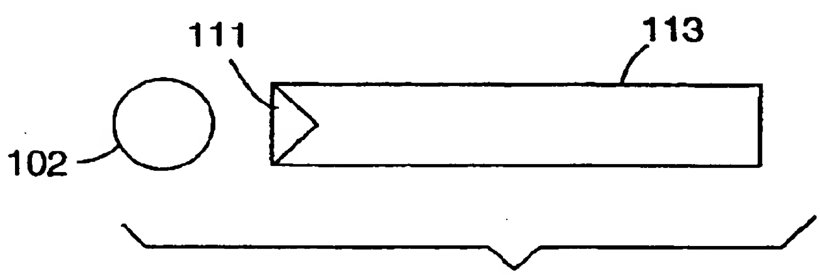
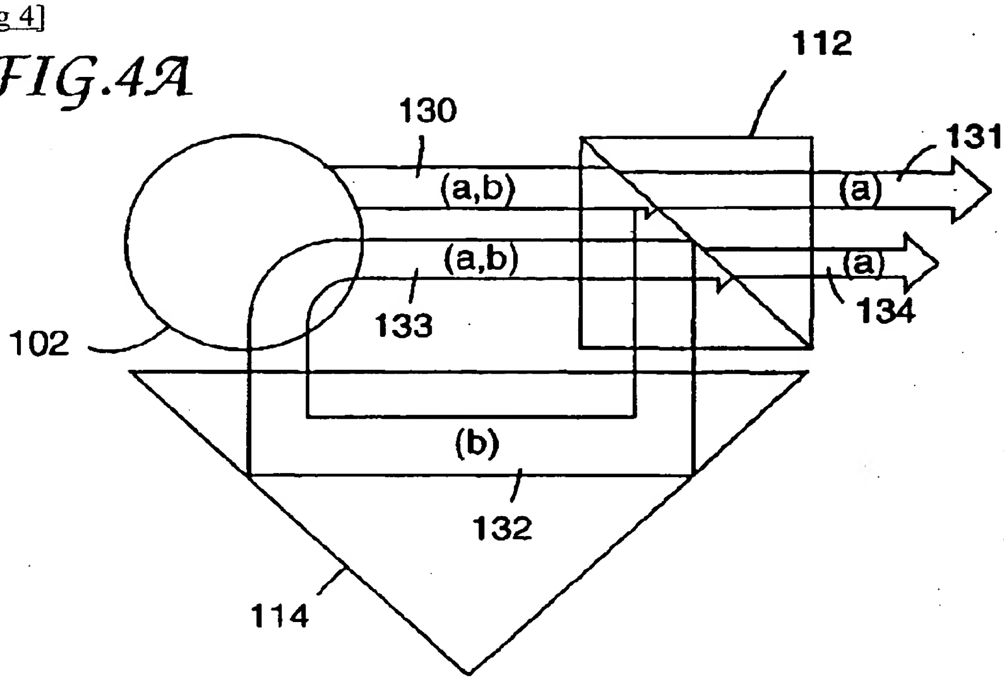


FIG.3C

[Drawing 4]

FIG.4A



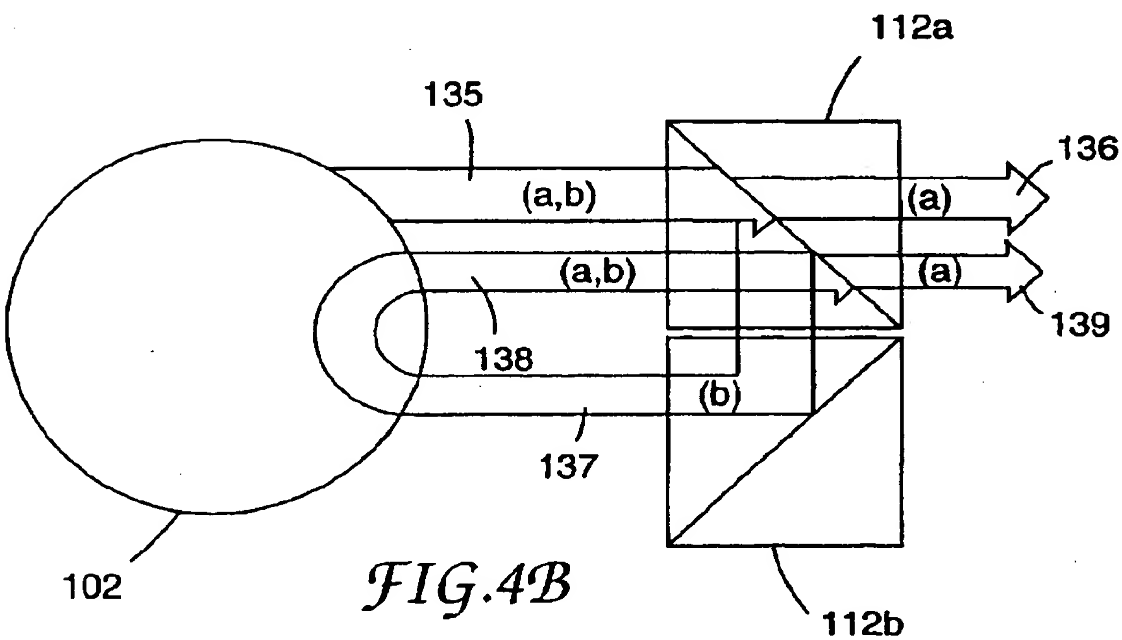


FIG.4B

[Drawing 5]

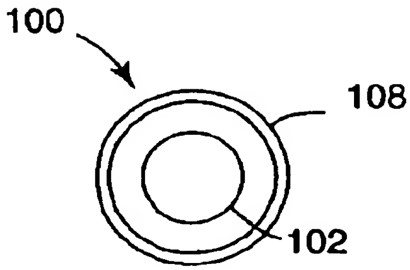


FIG.5A

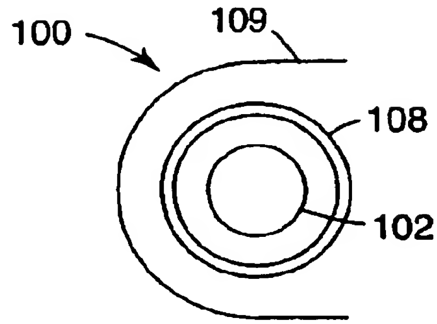


FIG.5B

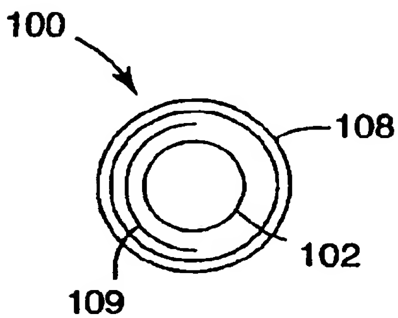


FIG.5C

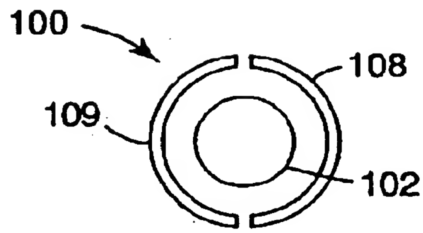


FIG.5D

[Drawing 6]

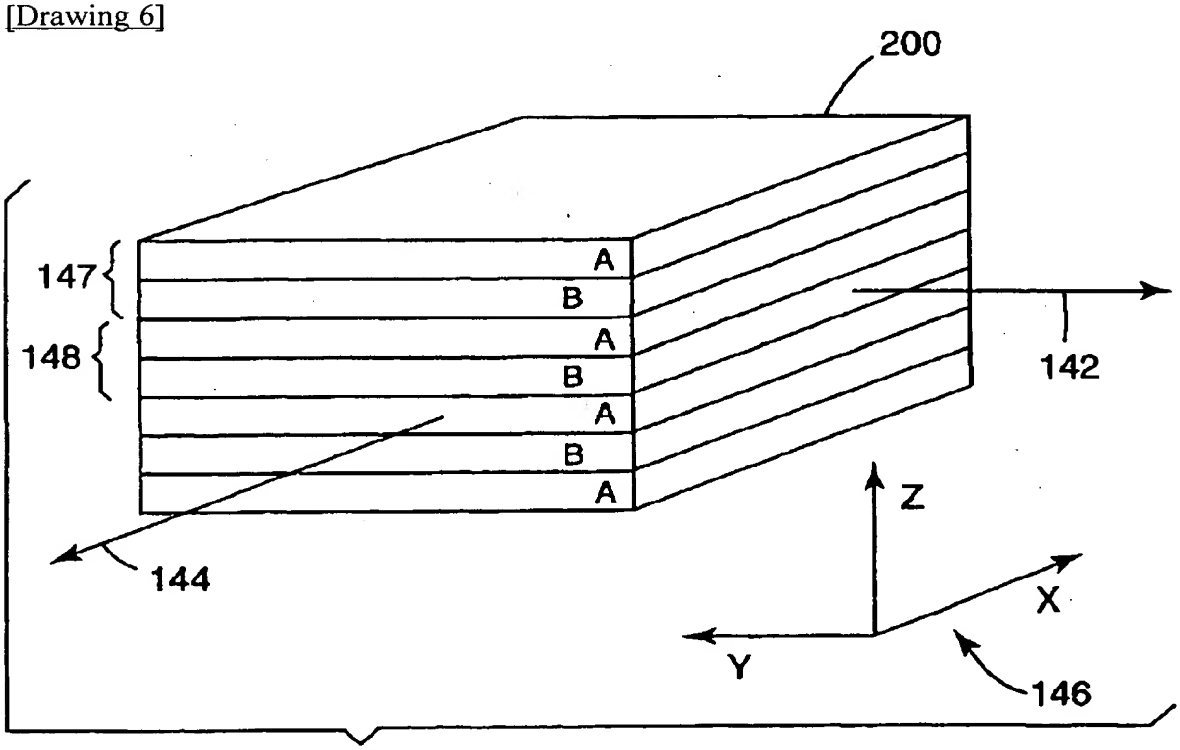


FIG. 6

[Drawing 7]

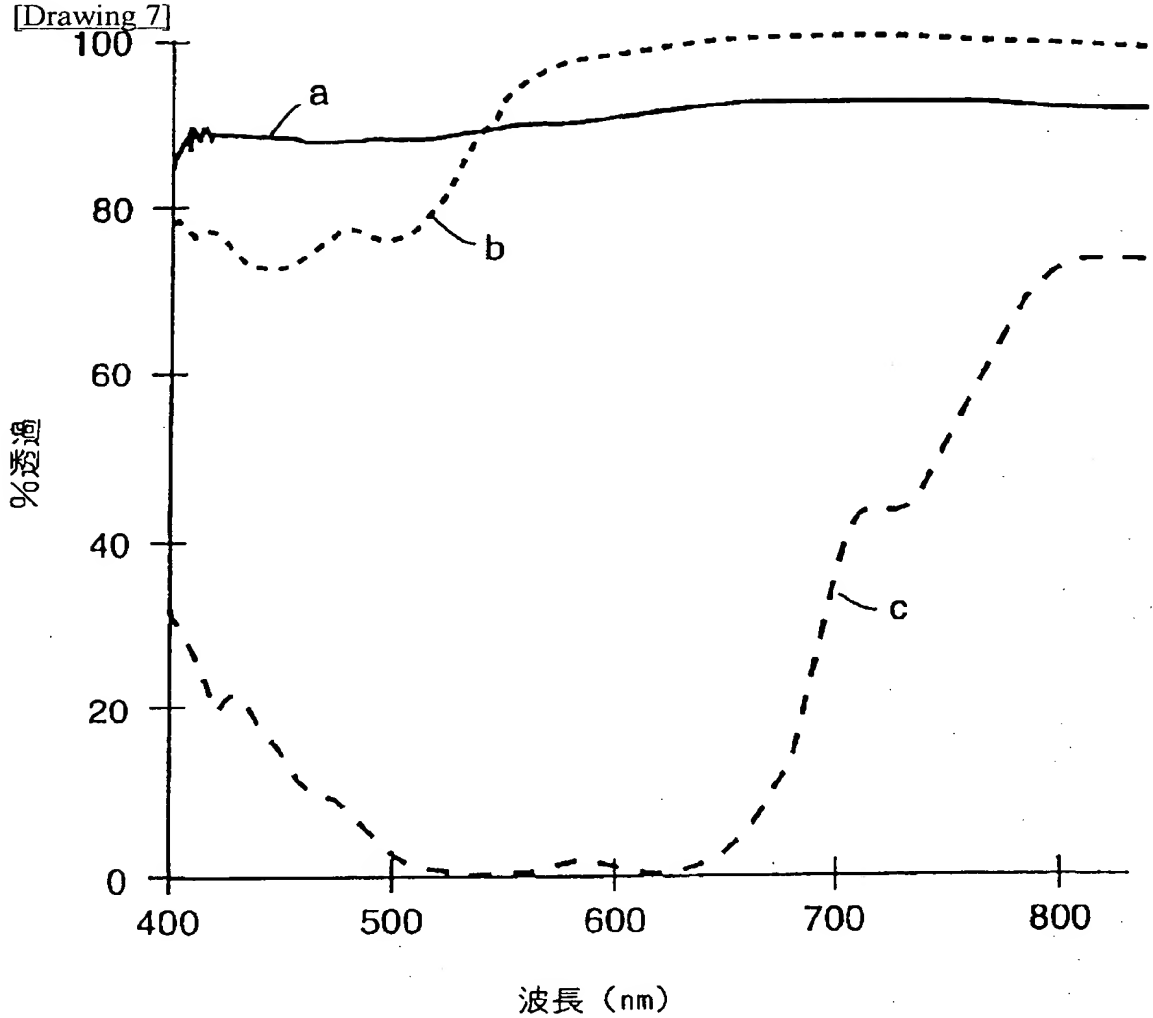


FIG.7A

[Drawing 7]

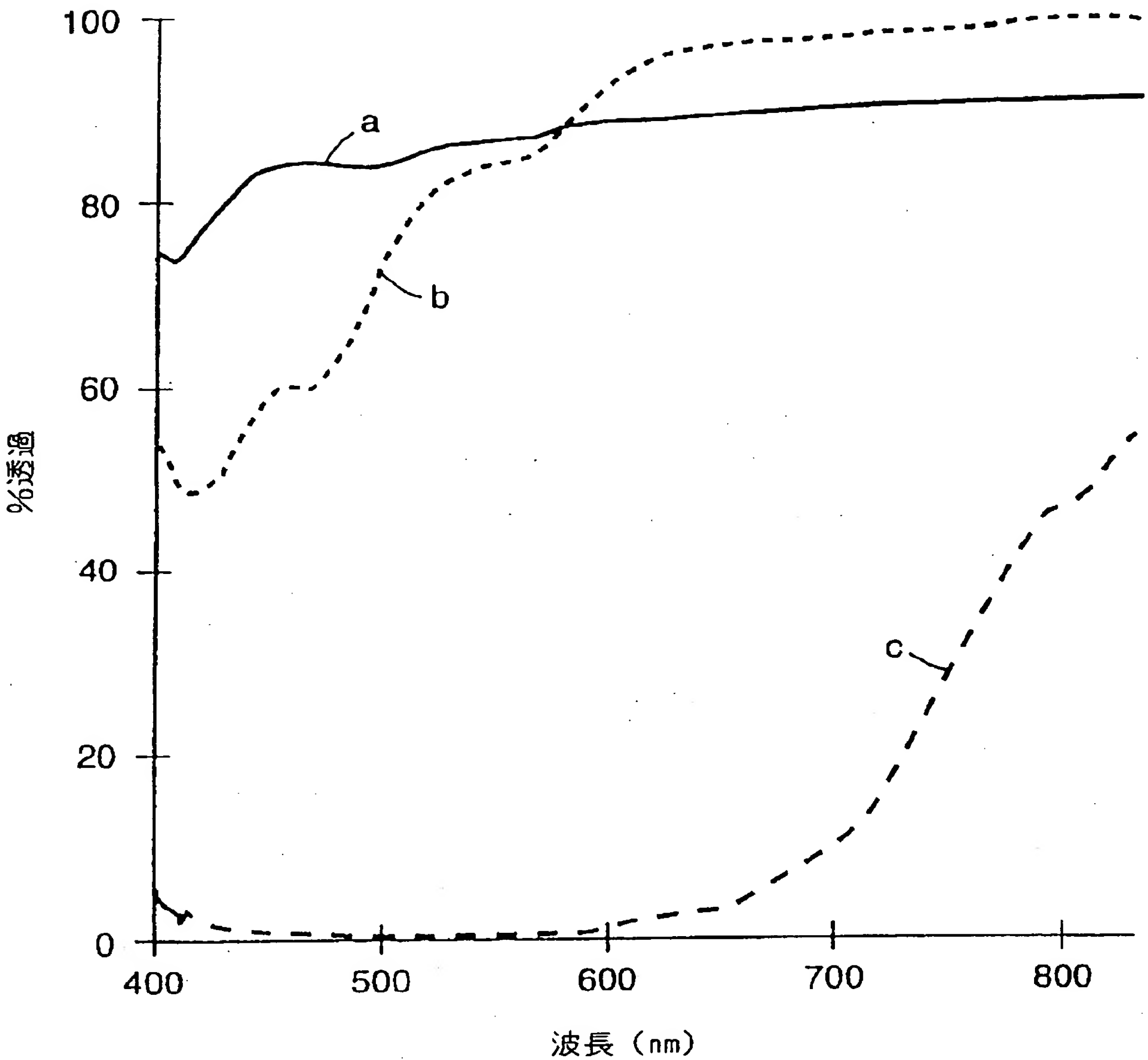


FIG.7B

[Drawing 7]

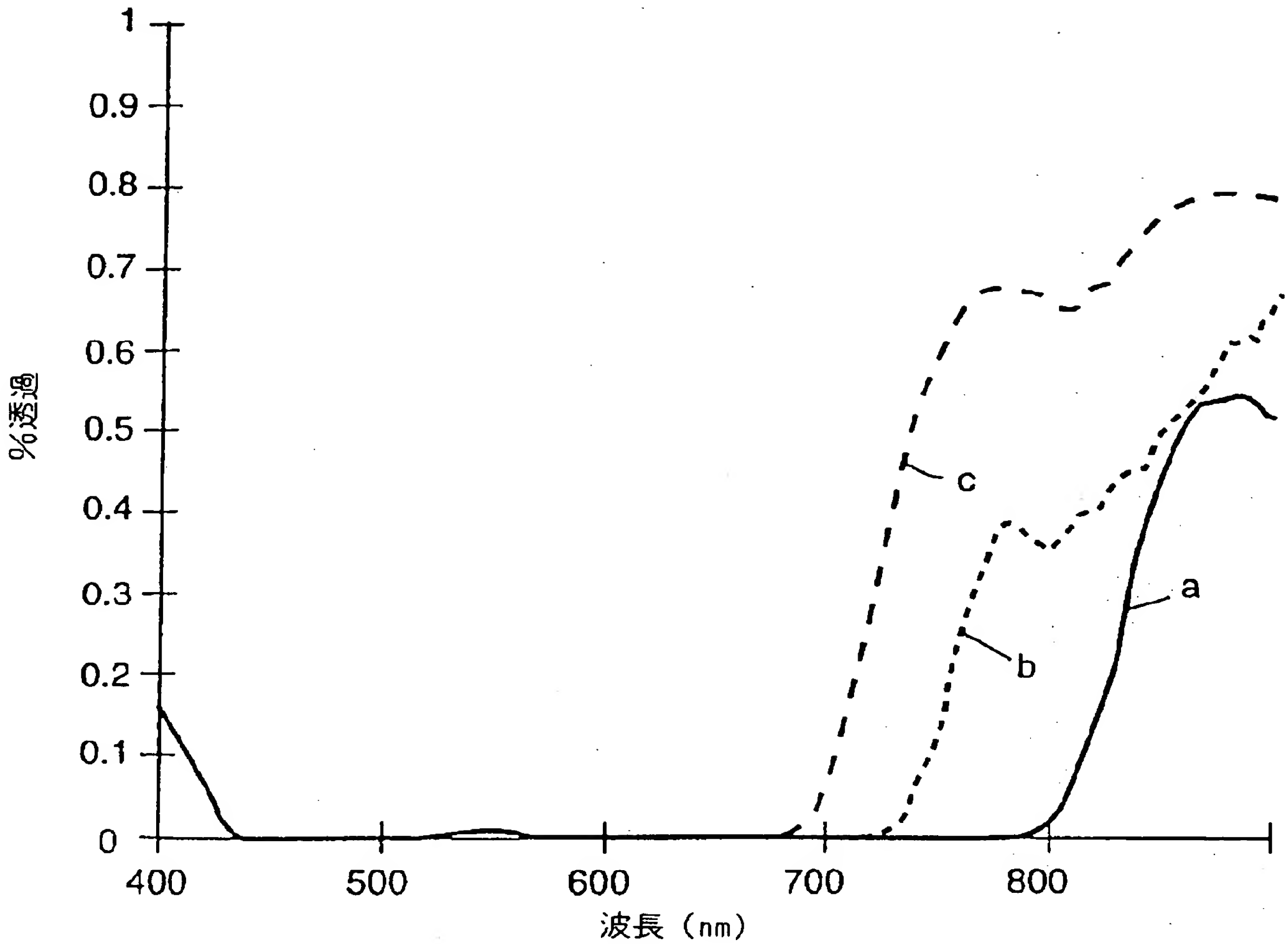


FIG.7C

[Drawing 8]

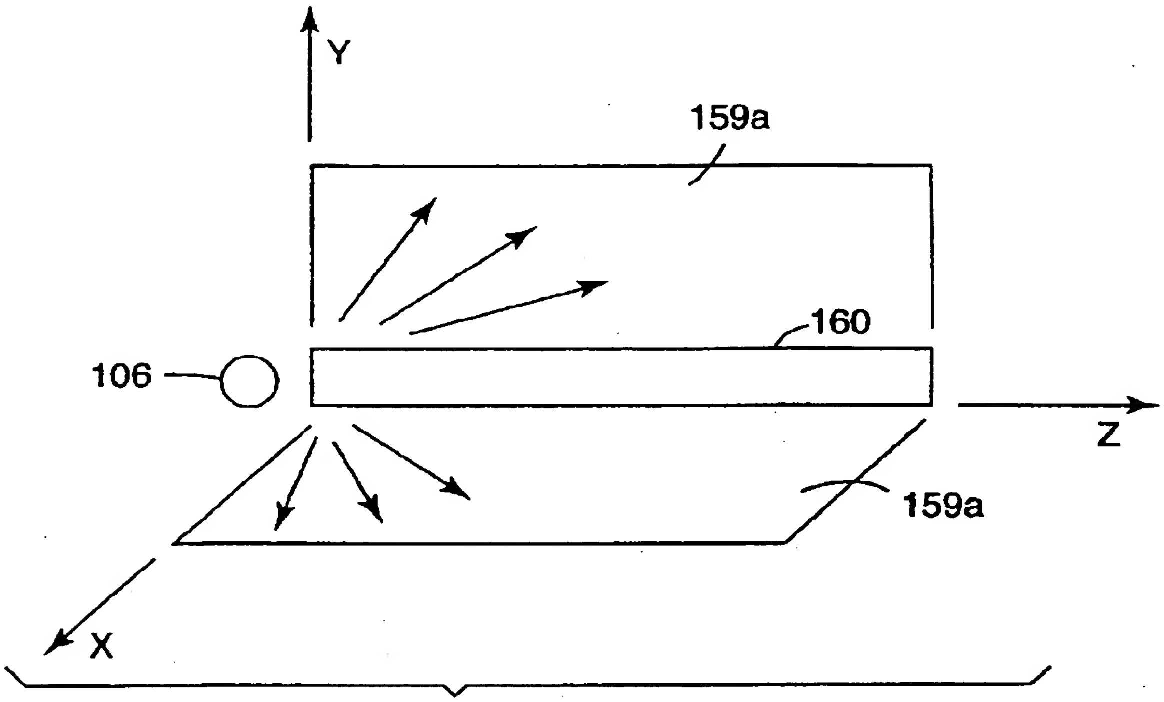


FIG.8A

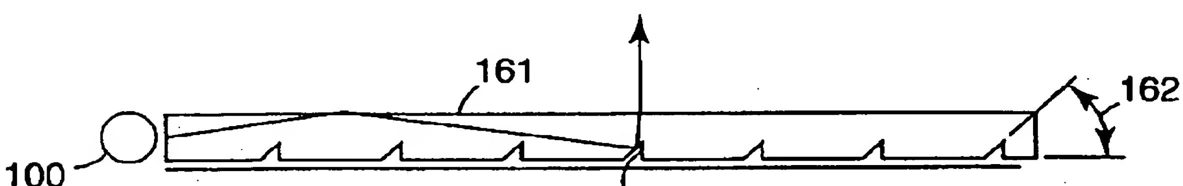


FIG.8B

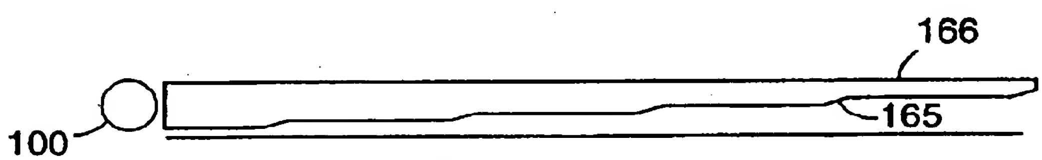


FIG.8C

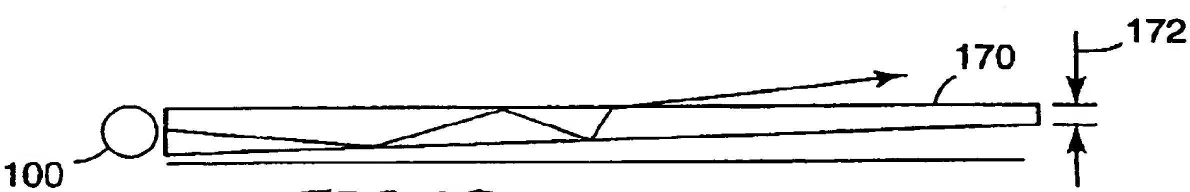


FIG.8D

[Drawing 9]

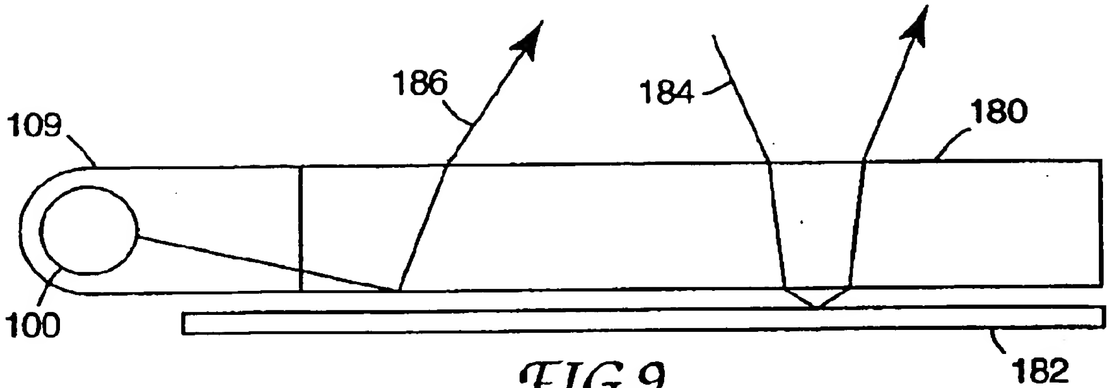


FIG.9

[Drawing 10]

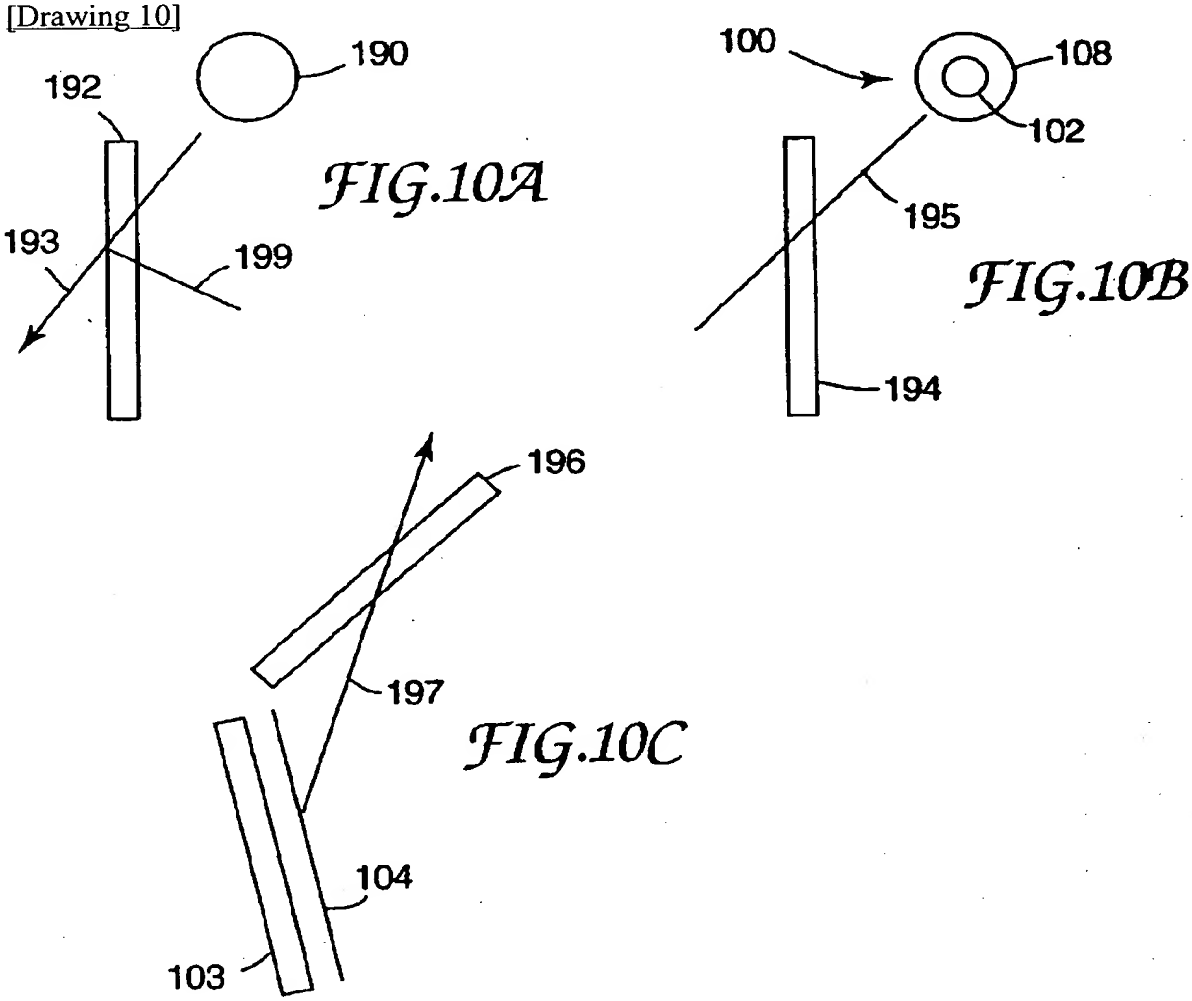


FIG.10A

FIG.10B

FIG.10C

[Translation done.]